ZOOPLANKTON DATA AND SAMPLE ARCHIVE DATABASE DESIGN FOR THE DORSET RESEARCH CENTRE

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INTRODUCTION

Freshwater zooplankton are sensitive indicators of the loss of aquatic ecosystem integrity in the face of environmental stress, and its recovery following the removal of the stress (e.g., Keller et al. 1990, Keller and Yan 1991). In consequence, the Biological Studies Unit of the Limnology Section of the Ontario Ministry of the Environment's Water Resources Branch has assembled long-term descriptions of zooplankton communities from selected lakes in the Sudbury, Haliburton, Muskoka, Parry Sound and Nipissing areas of Ontario as part of three programmes - the Sudbury Environmental Study (SES, Anon. 1982), the Lakeshore Capacity Study (LCS, Dillon et al. 1984) and the Acid Precipitation in Ontario Study (APIOS, Anon. 1990). These records are unique in two ways. There is an unusually good reference lake data set, i.e., monthly collections for at least 1 year from 56 limnologically-diverse lakes. Secondly, there are unsually long records, > 10 years, from 12 lakes. These data sets provide an excellent baseline description of zooplankton community structure and variability for Canadian Shield lakes, against which the detrimental impacts of future stressors and the benefical impacts of future regulatory or remedial actions can be assessed.

Because of the uniqueness and demonstrated value of these data, it is important that the samples are preserved, catalogued and maintained, that the sampling and enumeration protocols are documented and that the zooplankton database itself be clearly documented. In consequence, Yan et al. (1992) have described the construction and performance of the DRC (Dorset Research Centre) metered tow net, the collection gear routinely employed to collect zooplankton and Girard and Reid (1990) have described the zooplankton sampling schedules and sample enumeration protocols. The objective of this report is to describe the design of the zooplankton database - the electronic archive of the samples themselves and of the identification, enumeration and description of attributes of zooplankton species in samples.

The zooplankton database was designed with the following objectives:

- to track the location of samples as they are transferred to and returned from contract enumerators,
- to record the exact location of samples in the Dorset sample library,
- to record a complete description of each sample, e.g., date of collection, sampling crew, collection gear and protocol, lake, station, sample volume, and compositing method,
- to record any permanent alterations of the samples, e.g., removal of animals for confirmatory identification or formation of composite samples,
- to record a complete description of all enumerations of samples, e.g., taxonomist, count date, count protocol, and count hardware,
- to record the lengths, identities and other attributes of all taxa examined during an enumeration of a sample,
- to provide permanent records of all sampling gear employed, sampling sites visited, and zooplankton species encountered,
- to facilitate the maintenance of data quality,
- to record all alterations of the database, and
- to facilitate the maintenance of and access to zooplankton data collected in past, present, and future programmes within the Section.

Several types of database models exist, but because of the huge size of the database (hundreds of thousands of individual measurements of animals), and the diversity of its design objectives, we selected a relational database management system as our model (Atre 1980). The database was produced and resides in tables managed by the ORACLE (Version 6) database management system. The tables are accessed via a local area network on an OS2 server.

The data that populate the database have been generated in two major ways. Prior to 1985 they were generated by conventional identification and counts of zooplankton aided by dissecting microscopy. The counts were written on log sheets, then keyed into spreadsheets, statistical, or other software packages as needed. Since 1985 the data have been generated by a custom written software package called ZEBRA (Zooplankton Enumeration and Biomass Routines for APIOS), a semi-automated program that facilitates the identification, enumeration, measurement, and demographic description of animals in the samples. This package had its origin in the work of Sprules et al. (1981).

It is not the objective of this report to introduce the reader to the advantages of relational databases. The interested reader can consult, for example, Atre (1980) or Date (1990) for such a discussion. Nor is it our purpose to promote our particular database design to other zooplankton ecologists. The interests of each investigator will certainly govern the design of his or her database. Our purpose is simply to document the DRC zooplankton database in detail for those who wish to use the data or examine the samples in the future. Because of the uniqueness of the sample collections and data, we assume there will be many such users in the future.

OVERVIEW OF DATABASE DESIGN

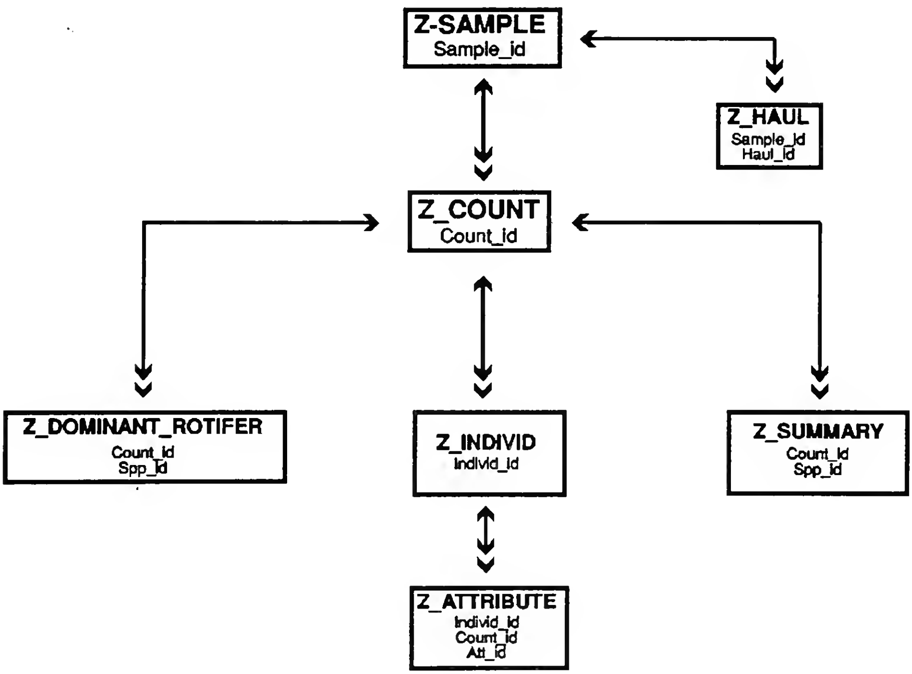
A relational dababase is perceived by its users simply as a collection of tables. Indeed the "relation" in "relational" is simply a mathematical term for a table (Date 1990). The zooplankton database consists of 17 tables. They can be grouped into three classes: Maintenance tables, Reference tables and Data tables. The five Maintenance tables (Z_REMOVE, Z_VOLUME, Z_COMPOSITE, Z_CHANGE and Z_NOMENCLATURE) document permanent alterations of the samples themselves or of any portion of the database. There are five Reference tables: Z_GEAR, Z_LAKE, Z_TAXA, Z_ATT_ID, and Z_CODE. The first four tables record, respectively, descriptions of all sampling gear, lakes sampled, Ontario zooplankton species, and individual animal's attributes recorded during the counts. Each of these tables grows very slowly if at all. For example, the Z_TAXA table only grows if species new to the entire database are encountered. The last reference table, Z_CODE, provides an explanation for all technician, protocol, hardware and flag codes scattered throughout the database. The entries for all columns with a title ending in "_CODE" are explained in this table.

The remaining seven tables comprise the zooplankton data themselves. These tables are hierarchically organized in what are termed master/detail relationships. Master and detail tables are associated in a simple manner. The detail table can contain more than one row of information associated with a single row in its master table. Consider the Z_SAMPLE - Z_COUNT couplet as an example (Figure 1). Each row in Z_SAMPLE uniquely describes a sample, providing the lake sampled, sampling date, sampling gear, etc. Each of the rows in Z_COUNT describes a single, complete session of enumeration of one of the samples, providing a unique count identifier, the count protocol employed, the taxonomist's name, etc. Because a sample can be counted more than once, there may be more than one row in Z_COUNT associated with a single row in Z_SAMPLE. In other words, Z_COUNT is a detail table of Z_SAMPLE. The other master detail couplets are illustrated in Figure 1.

There are three detail tables of Z_COUNT. Each row of Z_SUMMARY provides information about a single taxon in a count, for example, the numbers of that species counted, the subsample volume examined for that species, and its biomass and abundance. Z_DOMINANT_ROTIFER also provides a single row per taxon in the count; however, the only information provided is the identity and estimated rank abundance of rotifer taxa in the count. We have included this table in the database because this rotifer information is gathered during routine counts at little cost. At the end of a routine crustacean zooplankton count, the taxonomist spends a few additional minutes keying in the rotifer taxa observed and estimating their rank abundances. Z_INDIVID is the last detail table of Z_COUNT. Each of its rows provides the identity and length of each uniquely numbered individual that was identified, counted and measured during the count.

The last two data tables are Z_ATTRIBUTE and Z_HAUL. Z_ATTRIBUTE is a detail table of Z_INDIVID that records demographic data gathered during special zooplankton studies. Each of its rows provides attributes other than body length recorded for individuals examined during a count. For example, the taxonomist may have recorded the gender, numbers of eggs in a clutch, developmental stage, and body width of particular individuals whose unique identifiers are recorded in Z_INDIVID. The last data table, Z_HAUL, is a detail table of Z_SAMPLE. It describes the individual hauls taken with the DRC plankton net whose combined contents form the composite samples that are enumerated.

Figure 1 Master-detail relationship of the data tables. The single arrow head indicates the master table and the double, the detail table. The primary keys for these tables are in listed lower case letters.



The lengths of the tables grow in a cascading fashion along the master/detail relationship hierarchy (Figure 1). For example, on average 300 samples are collected in a year; hence, Z_SAMPLE will grow by about 300 rows a year. Roughly 10% of these sample will be counted twice for purposes of quality assurance, implying that Z_COUNT will grow by 330 rows a year. Because there are roughly 10 taxa of crustacean zooplankton identified in a standard count, roughly 3300 rows will be added to Z_SUMMARY each year. Assuming 250 individuals are counted and measured in each sample, 82,500 rows will be added to Z_INDIVID each year, i.e., 330 counts times 250 individuals. If two attributes other than length, e.g., gender and clutch size, are recorded for each individual counted, then Z_ATTRIBUTE would grow by 165,000 rows in the year, i.e., 2 attributes times 330 counts times 250 individuals. The size of the dataset provides a sufficient justification for the need for efficient organization of the data.

The use of the database is faciliated by the designation of primary and foreign keys. The former uniquely identify rows in a table, the latter provide linkages to other tables. These key columns are identified in Table 1. The remainder of this section details the design of each table in the database.. The order of presentation is Data tables, followed by Reference tables, and, finally, Maintenance tables. We conclude the report by providing the current contents of two of the reference tables, Z_TAXA (Table 2) and Z_CODE (Table 3).

Table 1 Summary of primary keys and foreign keys for the zooplankton database.

TABLE CODE	SOURCE TABLE	PRIMARY KEY(S)	FOREIGN KEYS	DESTINATION TABLE FOR FOREIGN KEYS
D1	Z_SAMPLE	SAMPLE_ID	GEAR_ID LAKE_ID	Z_GEAR Z_LAKE
D2	Z_HAUL	(SAMPLE_ID, HAUL_ID)	SAMPLE_ID	Z_SAMPLE
D3	Z_COUNT	COUNT_ID	SAMPLE_ID	Z_SAMPLE
D4	Z_SUMMARY	(COUNT_ID, SPP_ID)	COUNT_ID SPP_ID	Z_COUNT Z_TAXA
D5	Z_DOMINANT_ROTIFER	(COUNT_ID, SPP_ID)	COUNT_ID SPP_ID	Z_COUNT Z_TAXA
D6	Z_INDIVID	INDIVID_ID	COUNT_ID SPP_ID	Z_COUNT Z_TAXA
D7	Z_ATTRIBUTE	(INDIVID_ID, ATT_ID)	INDIVID_ID ATT_ID	Z_INDIVID Z_ATT_ID
R1	Z_GEAR	GEAR_ID		
R2	Z_LAKE	LAKE_ID		
R3	Z_TAXA	SPP_ID		
R4	Z_ATT_ID	ATT_ID		
R5	Z_CODE	(T_NAME, PARAMETER, CODE)		
M1	Z_REMOVE	(SAMPLE_ID, SPP_ID, ANIMAL_ID)	SAMPLE_ID SPP_ID	Z_SAMPLE Z_TAXA
M2	Z_VOLUME	(SAMPLE_ID, ZDATE)	SAMPLE_ID	Z_SAMPLE
M3	Z_COMPOSITE	(SAMPLE_ID, CONTRIBUTOR_ID)	SAMPLE_ID	Z_SAMPLE
M4	Z_CHANGE	(TNAME, KEY1, KEY 2, KEY3, PARAMETER, ZDATE)		
M5	Z_NOMENCLATURE	(SPPID_OLD, SPPID_NEW)		

THE ZOOPLANKTON DATABASE

D1 Z_SAMPLE TABLE

This table provides information about a particular sample, for example, where the sample was taken , when it was taken, how it was taken, who took it, and its location in the sample archive.

#	COLUMN	DATA TYPE
1	SAMPLE_ID	varchar (12) not null
2	LAKE	varchar (20) not null
3	STATION	varchar (11) not null
4	LAKE_ID	varchar (4) not null
5	ZDATE	date not null
6	ZTIME	varchar (4)
7	STN_NUM	varchar (9)
8	COMP_STNS	number
9	STYPE_CODE	varchar (5)
10	DEPTH	number
11	GEAR_ID	varchar (2)
12	TECH_CODE	varchar (5)
13	NUM_HAULS	number
14	CAL_CNT	number
15	CAL_TIME	varchar (5)
16	VOLUME	number
17	DRAWER	varchar (3)
18	BOTTLE	varchar (7)
19	LOC_CODE	varchar (5)
20	XS_CODE	varchar (5)
21	STUDY_CODE	varchar (5)
22	VOLCALC_CODE	varchar (5)
23	R_FLAG	varchar (1)
24	L_FLAG	varchar (1)
25	V_FLAG	varchar (1)

SAMPLE_ID This is a unique identifier for each sample. Since 1980, SAMPLE_ID for the routine DRC samples has been six characters long beginning with the letter Z. SAMPLE_ID is the Primary Key for this table.

LAKE The name of the lake, excluding the word "LAKE". The column is constrained to accept upper case letters only.

STATION	The DRC eleven digit code used to identify sampling stations in the "WATER" table. This is a foreign key to "W_STATION". The "WATER" table is the database table containing all DRC lake and stream chemistry data. "W_STATION" is an associated table describing sampling locations.
LAKE_ID	The 4 character lake code assigned in ZEBRA, the custom counting software package. When two lakes have the same name and one or both have not been assigned STATION numbers, this code uniquely identifies the lake. This is a foreign key to Z_LAKE.
ZDATE	Contains the date on which the sample was taken. This column is in Oracle date format but does not contain the time.
ZTIME	The time at which the sample was taken. It is a four digit character field in the format "HHMM".
STN_NUM	The name or number of the station where the sample was collected. This number is unique to the zooplankton programme, i.e., it is not in "W_STATION".
COMP_STNS	The number of stations in a composite sample.
STYPE_CODE	The type of sample, e.g., composite. This column is keyed to the "Z_CODE" table.
DEPTH	Depth (in metres) of discrete sample.
GEAR_ID	A code that keys to the "Z_GEAR" table. "Z_GEAR" supplies a complete description of the coded gear.
TECH_CODE	Provides the abbreviated name of the person heading the crew that took the sample. This column is keyed to the "Z_CODE" table.
NUM_HAULS	The number of hauls taken to form composite sample.
CAL_CNT	The calibration haul count for a composite formed from multiple hauls with a DRC plankton net (Yan et al. 1992). See Girard and Reid (1990) for description of haul strategies for composites.
CAL_TIME	The time (in seconds) required to pull the meter, used with a DRC plankton net, through the water column during the calibration haul.
VOLUME	The original volume (in litres) of lake water represented in the sample.

DRAWER	Number of the file drawer containing the sample bottle in the DRC sample archive.
BOTTLE	The code number of the bottle in the above named drawer. This number is not the same as the SAMPLE_ID.
LOC_CODE	A code for the present location of the sample. The "Z_CODE" table explains this code.
XS_CODE	Code for non-routine sample types to indicate that this particular sample should not be used in routine queries. The "Z_CODE" table provides details.
STUDY_CODE	A code for the project for which this sample was taken, e.g., APIOS. This column is keyed to the "Z_CODE" table.
VOLCALC_CODE	A code to describe the method that was used to calculate the volume of the sample. Details are explained in the "Z_CODE" table.
R_FLAG	Flag to indicate that this sample is a routine DRC sample to be included in all regular data analysis. Upper case "F" is used as a flag.
A_FLAG	Indicates that some animals have been removed. The "Z_REMOVE" table provide details if the "A_FLAG" is not null. "F" is used as the flag.
V_FLAG	Indicates that volume has been removed to make a composite. The "Z_COMPOSITE" table provides details if the "V_FLAG" is not null. "F" is used as the flag.

D2 Z_HAUL TABLE

The Z_HAUL table describes the tow net hauls used to form routine composite samples with a DRC plankton net (Yan et al. 1992).

#	COLUMN	DATA TYPE
1	SAMPLE_ID	varchar (12) not null
2	HAUL_ID	number not null
3	TOW_LENGTH	number
4	TOW_CNT	number
5	TOW_TIME	varchar (5)
6	R_FLAG	varchar (1)

SAMPLE_ID Sample identifier, keyed to the Z_SAMPLE table.

HAUL_ID Uniquely identifies the haul in this sample.

TOW_LENGTH The length (in metres) of this particular haul. It is assumed that the net was hauled vertically from this depth to the surface.

TOW_CNT The impeller reading from the DRC net associated with this HAUL_ID.

TOW_TIME The time (in sec.) taken to pull the meter and net through the water column for this haul.

R_FLAG Flag to indicate that this HAUL_ID should be included in routine queries. Upper case "F" is used as the flag.

D3 Z_COUNT TABLE

The Z_COUNT table provides selected summary information from a single complete enumeration of a sample.

#	COLUMN	DATA TYPE
1	COUNT_ID	varchar (7) not null
2	CNT_TYPE_CODE	varchar (5)
3	CNT_SYSTEM_CODE	varchar (5)
4	SAMPLE_ID	varchar (12) not null
5	TECH_CODE	varchar (5)
6	ZDATE	date
7	CNT_PRTCL_CODE	varchar (5)
8	NUM_SPP	number
9	NUM_INDIVID	number
10	ROTIFER_INDEX_CODE	varchar (5)
11	CNT_GRP_CODE	varchar(5)
12	COMMENTS	varchar (20)
13	R_FLAG	varchar (1)
14	OMIT_CODE	varchar (5)

COUNT_ID A unique code for each unique enumeration of a sample. Routinely, such an enumeration involves the identification, counting and measurement of 250 animals. "COUNT_ID" is the primary key for this table.

CNT_TYPE_CODE

This code reports the class of enumeration that was performed on this sample, e.g., QA/QC. Explanation of codes are provided in the "Z_CODE" table.

CNT_SYSTEM_CODE

Code to describe the hardware that was used to execute the count of this sample, e.g., "Z2S1" could mean Zebra2 system, Sprules calipers #1. The code is explained in the "Z_CODE" table.

SAMPLE_ID The unique code for this particular sample. This is keyed to the "Z_SAMPLE" table.

TECH_CODE Code identifying the technician who performed the enumeration. Details are found in the "Z_CODE" table.

ZDATE The date of this count. It does not include the time.

CNT_PRTCL_CODE

Identifies the counting protocol that was employed. Entries are explained in the "Z_CODE" table.

NUM_SPP The number of different taxa identified in this count of this sample.

NUM_INDIVID The total number of individuals that were counted.

ROTIFER_INDEX_CODE

Code for the relative abundance of rotifers in this count. Details are found in the "Z_CODE" table.

CNT_GRP_CODE

Identifies the group of organisms that were targeted in this enumeration of the sample, e.g., Rotifera and Crustacea. The codes are described in the "Z_CODE" table.

COMMENTS Comments recorded by the taxonomist concerning this count.

R_FLAG Flag to indicate that this count is one of the DRC's regular counts to be included in routine queries. An upper case "F" is used as the flag.

OMIT_CODE Entries indicate that there has been a problem with this particular count. The entries are explained in the "Z_CODE" table.

D4 Z_SUMMARY TABLE

The Z_SUMMARY table summarizes the data for each species found in each count.

#	COLUMN	DATA TYPE
1	COUNT_ID	varchar (7) not null
2	SPP_ID	varchar (3) not null
3	FA	number
4	NUM_CT	number
5	DENSITY	number
6	BIOMASS	number
7	NONZEB_WEIGHT	number
8	W_CODE	varchar (5)
9	SUML	number
10	SUMW	number
11	MINL	number
12	MAXL	number
13	A	number
14	B	number
15	LWR_CODE	varchar (5)
16	R_FLAG	varchar (1)

COUNT_ID Key to the Z_COUNT table that uniquely identifies the count of this particular sample.

SPP_ID Species identification code as described in the Z_TAXA table.

FA The fraction of the sample that was counted for this species. The value is required to calculate animal density or biomass, and must be > 0 and ≤1.

NUM_CT The number of animals of this species that was counted in the above fraction of the sample.

DENSITY The abundance of this taxon (in $\#/m^3$).

BIOMASS The biomass of this taxon (in mg dry weight/m^3).

NONZEB_WEIGHT
The mean individual weight (in μg dw) of this taxon. The source of this weight is provided by "W_CODE".

W_CODE	A code described in "Z_CODE" that explains the biomass calculation method, e.g., "ZEB" if the biomass was calculated from measurements of animals in the count.
SUML	The sum of the lengths (in mm) of the measured animals.
SUMW	The sum of the calculated dry weights (in μg) of counted animals.
MINL	The minimum length check for this species. This is not the smallest animal encountered in the sample, rather it is a length used for QC purposes during the count.
MAXL	The maximum length check for this species. This is not the largest animal encountered in the sample, rather it is a length used for QC purposes during the count.
A	The value of "a" in the length (L) weight (W) regression equation $W = aL^b$.
B	The value of "b" in the length (L) weight (W) regression equation $W = aL^b$.
LWR_CODE	A code that keys back to the "Z_CODE" table providing the source of that length (L) weight (W) regression equation.
R_FLAG	The flag to indicate that the data for this taxon are to be included in routine queries. The upper case character "F" is used as the flag.

D5 Z_DOMINANT_ROTIFER TABLE

The Z_DOMINANT_ROTIFER table provides the estimated rank abundance of the rotifers observed in a count of a sample.

#	COLUMN	DATA TYPE
1	COUNT_ID	varchar (7) not null
2	SPP_ID	varchar (3) not null
3	TAXON_RANK	number

COUNT_ID	Key to the "Z_COUNT" table that uniquely identifies the count of this particular sample. The sample is described in the "Z_SAMPLE" table.
SPP_ID	Species identification code from the Z_TAXA table.

TAXON_RANK A rank for this species in this count, "1" indicating the most abundant taxon.

D6 Z_INDIVID TABLE

The Z_INDIVID table contains the individual animal's measured lengths.

#	COLUMN	DATA TYPE
1	INDIVID_ID	number not null
2	COUNT_ID	varchar (7) not null
3	SPP_ID	varchar (3)
4	LENGTH	number
5	R_FLAG	varchar (1)

INDIVID_ID An identification number that, together with "COUNT_ID", uniquely identifies an individual animal.

COUNT_ID Key to the "Z_COUNT" table that uniquely identifies the count of this particular sample.

SPP_ID Taxon identification number. This is keyed to the "Z_TAXA" table.

LENGTH The measured length of the animal (in mm).

R_FLAG Flag to indicate that individual should be included in routine queries. Upper case "F" is the flag.

D7 Z_ATTRIBUTE TABLE

The Z_ATTRIBUTE table provides a flexible means of recording attributes, other than body lengths, of each individual animal. The "Z_ATT _ID" table (number R4) provides the details for each attribute code (ATT_ID).

#	COLUMN	DATA TYPE
1	INDIVID_ID	number not null
2	COUNT_ID	varchar(7) not null
3	ATT_ID	varchar (4) not null
4	ATT_VAL	varchar (20)

INDIVID_ID An identification number that, together with "COUNT_ID", uniquely identifies an individual animal that was measured.

COUNT_ID Key to the "Z_COUNT" table that uniquely identifies the count of this particular sample.

ATT_ID Unique key to the "Z_ATT_ID" table that identifies a particular attribute, e.g., # of eggs, or length of a body part.

ATT_VAL The entry for this attribute. Units are provided in the "Description" column in "Z_ATT_ID", where applicable.

R1 Z_GEAR TABLE

The Z_GEAR table describes all of the zooplankton sampling gear used by the DRC since it began collecting zooplankton during the Sudbury Environment Study in 1973.

#	COLUMN	DATA TYPE
1	GEAR_ID	varchar (2) not null
2	TYPE_CODE	varchar (5)
3	DESCRIPTION	varchar (35)
4	MESH	number
5	DIAMETER	number
6	AREA	number
7	VOLUME	number
8	COMMENTS	varchar (65)

GEAR_ID A code assigned to a particular sampling gear.

TYPE_CODE A descriptive code the tells the user if the gear was a net, Schindler/Patalas trap, etc. The "Z_CODE" table explains the codes.

DESCRIPTION A description of the gear, e.g., closing conical metered net.

MESH The aperture size (in μm) of the filtering mesh portion of the apparatus.

DIAMETER The inside diameter (in cm) of the mouth of a net-type apparatus. The column is null if the gear is not a net. Nets are assumed to have circular mouths.

AREA The area (in m^2) of the mouth of a net.

VOLUME The volume (in litres) of a fixed volume sampler, e.g., a Schindler/Patalas trap.

COMMENTS Descriptive comments, such as where and when the gear was used.

R2 Z_LAKE TABLE

The Z_LAKE table contains a list of all the lakes and locations from which the DRC has collected samples of zooplankton.

#	COLUMN	DATA TYPE
1	LAKE	varchar (20) not null
2	STATION	varchar (11)
3	LAKE_ID	varchar (4)
4	EASTING	number
5	NORTHING	number

LAKE The name of the lake without the extension "lake". The column is constrained to accept only upper case letters.

STATION The standard DRC eleven digit code used in the "WATER" table. This a foreign key to "W_STATION".

LAKE_ID The 4 character lake code used by ZEBRA, the custom counting software package employed by the DRC.

EASTING The geographic easting grid reference in the Universal Transverse Mercator Grid System (UTM).

NORTHING The geographic northing grid reference in the Universal Transverse Mercator Grid System (UTM).

R3 Z_TAXA TABLE

The Z_TAXA table provides the scientific name and coded identifier for all the zooplankton taxa in the database.

#	COLUMN	DATA TYPE
1	SPP_ID	varchar (3) not null
2	SPP_ABBREV	varchar(10)

3	SPP_NAME	varchar (40)
4	T_FLAG	varchar (1)

SPP_ID The 3 digit numeric code for taxa that is used throughout the database. The 100, 200 and 300 series are reserved for Cladocera, Calanoida and Cyclopoida, respectively. The 400 and 500 series are reserved for Rotifera and the 600 series for macrozooplankton such as larval *Chaoborus*. The 700 series records miscellaneous taxa such as macro-algae.

SPP_ABBREV An abbreviated name of the taxon, e.g., B. long. = *Bosmina longirostris.*

SPP_NAME Full scientific name (Latin binomial) with authority for each taxon.

T_FLAG To indicate if the nomenclature has been changed over time, an upper case "F" is used as the flag.

R4 Z_ATT_ID TABLE

The Z_ATT_ID table provides a detailed description of the attribute codes.

#	COLUMN	DATA TYPE
1	ATT_ID	varchar (4) not null
2	ATT_TYPE	varchar (1)
3	DESCRIPTION	varchar (20)

ATT_ID A unique code for the assigned attribute.

ATT_TYPE The attribute type: C (character), N (numeric), T (tabled) or M (measurement). Type C is a character string. Type N will generally be a count, e.g., 4 eggs. Type T represents a character string where all possible values can be prespecified, e.g., male or female gender. Type M represents a measurement of some body part other than total length.

DESCRIPTION Brief description of the attribute and, where appropiate, its units.

R5 Z_CODE TABLE

The "Z_CODE" table (see Table 3) provides the user with a flexible and efficient means of defining the codes used throughout all of the database tables. We have used the convention of ending a column name with "_CODE" to indicate that all possible entries in this column are explained in this table.

#	COLUMN	DATA TYPE
1	T_NAME	varchar (20) not null
2	PARAMETER	varchar (20) not null
3	CODE	varchar (5) not null
4	DESCRIPTION	varchar (60)

T_NAME The name of the table containing the code.

PARAMETER The column in the above table containing the code.

CODE The code used. It must be unique and five or less characters in length.

DESCRIPTION A detailed explanation of the code.

M1 Z_REMOVE TABLE

The Z_REMOVE table records the permanent removal of any animals from samples, for example, for shipment to other researchers in collaborative work.

#	COLUMN	DATA TYPE
1	SAMPLE_ID	varchar (12) not null
2	SPP_ID	varchar (3) not null
3	ANIMAL_ID	number not null
4	LENGTH	number
5	ZDATE	date
6	TECH_CODE	varchar (5)
7	COMMENTS	varchar (20)

SAMPLE_ID The unique sample identifier code, keyed to the Z_SAMPLE table.

SPP_ID Species identification code described in the Z_TAXA table.

ANIMAL_ID A unique identification number for the animal that was removed from the sample. There is no relation between this column and "INDIVID_ID" in the "Z_INDIVID" table.

LENGTH The length (in mm) of the removed animal.

ZDATE The date the animal was removed.

TECH_CODE The code for the technician that removed the animal. The code is explained in the "Z_CODE" table.

COMMENTS The reason that the animal was removed.

M2 Z_VOLUME TABLE

The Z_VOLUME table documents the permanent removal of partial volumes from a sample, e.g., to create a composite sample. A flag will the added to "V_FLAG" in the "Z_SAMPLE" table when this is done.

#	COLUMN	DATA TYPE
1	SAMPLE_ID	varchar (12) not null
2	ZDATE	date not null
3	TECH_CODE	varchar (5)
4	NEW_VOLUME	number
5	TECHNIQUE_CODE	varchar (5)

SAMPLE_ID The unique sample identifying code, keyed to the Z_SAMPLE table.

ZDATE The date the sample was manipulated.

TECH_CODE The code for the technician that removed the partial volume. The technician's name will be found in the "Z_CODE" table.

NEW_VOLUME
The new, final volume of the sample (in litres).

TECHNIQUE_CODE
A code for the technique used to manipulate the sample. Details will be found in "Z_CODE".

M3 Z_COMPOSITE TABLE

This table documents the removal of a fraction of a sample to produce a composite.

#	COLUMN	DATA TYPE
1	SAMPLE_ID	varchar (12) not null
2	CONTRIBUTOR_ID	varchar (12) not null
3	C_PERCENT	number not null

SAMPLE_ID The sample identification code of the new composite sample being produced.

CONTRIBUTOR_ID The sample identification code of the sample contributing volume to the new composite sample.

C_PERCENT The percent of the new composite sample donated by the contributor.

M4 Z_CHANGE TABLE

The Z_CHANGE table documents all updates (editing) of the database. Because some tables have more then one primary key, "KEY1", "KEY2" and ,"KEY3" refer to the primary keys of a particular table (TNAME) that uniquely identify a row in that table.

#	COLUMN	DATA TYPE
1	TNAME	varchar (20) not null
2	KEY1	varchar (20) not null
3	KEY2	varchar (20) not null
4	KEY3	varchar (20) not null
5	PARAMETER	varchar (20) not null
6	TECH_CODE	varchar (5)
7	ZDATE	date
8	OLD_VALUE	varchar (5)
9	NEW_VALUE	varchar (5)
10	COMMENTS	varchar (25)

TNAME Name of table that was updated.

KEY1
KEY2
KEY3 The three key columns refer to the primary columns of the table which is being updated. The number of non-null entries in these three KEYs will equal the number of primary key columns in the table.

PARAMETER The name of the column being updated.

TECH_CODE A character code identifying the database manager that performed the update. The code is explained in the "Z_CODE" table.

ZDATE The date on which the update was made.

OLD_VALUE The value being replaced.

NEW_VALUE The new value.

COMMENTS A brief description of the justification for changing the value or an indication of the source of the change.

M5 Z_NOMENCLATURE

This is a table that records any changes in names of taxa. These changes could represent new species, changes in names of existing species, combinations of species, or separation of old species into several new species.

#	COLUMN	DATA TYPE
1	ZDATE	date not null
2	CHNG_CODE	varchar (5)
3	SPPID_OLD	number not null
4	SPPID_NEW	number not null
5	CITATION	varchar (50)
6	COMMENTS	varchar (100)

ZDATE The date on which the new nomenclature was incorporated into the routine counting protocol.

CHNG_CODE The type of change, i.e., a new species, a renaming of an old species, or a lumping together or splitting of old species. The codes are explained in the Z_CODE table.

SPPID_OLD The old 3 digit species identification code. See Z_TAXA for details.

SPPID_NEW The new 3 digit species identification code. See Z_TAXA for details.

CITATION The reference (first author, date, journal, volume and page) that justifies the change in nomenclature.

COMMENTS A comment on the change.

ACKNOWLEDGEMENTS

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Table 2 Names and codes of taxa in the Z_TAXA table.

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
101	ACA CURV	*Acantholeberis curvirostris*
102	ACR HARP	*Acroperus harpae*
103	ALO AFFI	*Alona affinis*
104	ALO COST	*Alona costata*
105	ALO GUTT	*Alona guttata*
106	ALO INTE	*Alona intermedia*
107	ALO QUAD	*Alona quadrangularis*
108	ALO RECT	*Alona rectangula*
109	ALO SP	*Alona sp.*
110	BOS LONG	*Bosmina longirostris*
111	CER LAC	*Ceriodaphnia lacustris*
112	CER MEG	*Ceriodaphnia megalops*
113	CER PUL	*Ceriodaphnia pulchella*
114	CER RETIC	*Ceriodaphnia reticulata*
115	CER SP	*Ceriodaphnia sp.*
116	CHY BIC	*Chydorus bicornutus*
117	CHY PIG	*Chydorus piger*
118	CHY SPHA	*Chydorus sphaericus*
119	DAP AMB	*Daphnia ambigua*
120	DAP CAT	*Daphnia catawba*
121	DAP DUB	*Daphnia dubia*
122	DAP G ME	*Daphnia galeata mendotae*
123	DAP LONG	*Daphnia longiremis*
124	DAP PUL	*Daphnia pulicaria*
125	DAP PARV	*Daphnia parvula*
126	DAP PUL	*Daphnia pulex*
127	DAP RETR	*Daphnia retrocurva*
128	DAP ROS	*Daphnia rosea*
129	DAP SCHO	*Daphnia schodleri*
130	DIA BRAC	*Diaphanosoma brachyurum*
131	DIA LEU	*Diaphanosoma leuchtenbergianum*
132	EUB COR	*Eubosmina coregoni*
133	EUB TUB	*Eubosmina tubicen*
134	EUR LAM	*Eurycercus lamellatus*
135	HOL GIBB	*Holopedium gibberum*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
136	ILY SPIN	*Ilyocryptus spinifer*
137	LAT SET	*Latona setifera*
138	LEP KIN	*Leptodora kindtii*
139	MAC LAT	*Macrothrix laticornis*
140	OPH GRAC	*Ophryoxus gracilis*
141	PLE HAMU	*Pleuroxus hamulatus*
142	POL PED	*Polyphemus pediculus*
143	SCA AURI	*Scapholeberis aurita*
144	SCA KIN	*Scapholeberis kingi*
145	SID CRYS	*Sida crystallina*
146	SIM SERR	*Simocephalus serrulatus*
147	SIM VETU	*Simocephalus vetulus*
148	STR SERR	*Streblocercus serricaudatus*
149	BYT CEDE	*Bythotrephes cederstroemi*
150	EUB LONG	*Eubosmina longispina*
151	CER QUAD	*Ceriodaphnia quadrangula*
152	DIA BIRG	*Diaphanosoma birgei*
153	CHY GLOB	*Chydorus globosus*
155	AL ACUT	*Alonella acutirostris*
156	EUB SP	*Eubosmina sp.*
160	ACAN SP	*Acantholeberis sp.*
161	ACROP	*Acroperus sp.*
162	ALONEL	*Alonella sp.*
163	ANCHIS	*Anchistropus sp.*
164	BOS SP	*Bosmina sp.*
165	BYTHO SP	*Bythotrephes sp.*
166	CAMPTO	*Camptocercus sp.*
167	CHY SP	*Chydorus sp.*
168	DAP SP	*Daphnia sp.*
169	DIA SP	*Diaphanosoma sp.*
170	EURYC SP	*Eurycercus sp.*
171	EUB SP	*Eubosmina sp.*
172	GRAP SP	*Graptoleberis sp.*
173	HOL SP	*Holopedium sp.*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
174	ILY SP	*Ilyocrytus sp.*
175	KUR SP	*Kurzia sp.*
176	LATON SP	*Latona sp.*
177	LEPTO SP	*Leptodora sp.*
178	MACROTH	*Macrothrix sp.*
179	OPHR SP	*Ophryoxus sp.*
180	OXY SP	*Oxyurella sp.*
181	PLEU SP	*Pleuroxus sp.*
182	POLYP SP	*Polyphemus sp.*
183	PSEUD SP	*Pseudochydorus sp.*
184	SCAP SP	*Scapholeberis sp.*
185	SIDA SP	*Sida sp.*
186	SIMOC SP	*Simocephalus sp.*
187	DAP MIDD	*Daphnia middendorffiana*
199	UNID CLAD	*Unidentified Cladoceran*
201	CAL COP	*Calanoid copepodid*
202	LEPTO ASHL	*Leptodiaptomus ashlandi*
203	AGLA LEPT	*Aglaodiaptomus leptopus*
204	LEPTO MIN	*Leptodiaptomus minutus*
205	SKIS OREG	*Skistodiaptomus oregonensis*
206	SKIS REIG	*Skistodiaptomus reighardi*
207	ONY SANG	*Onychodiaptomus sanguineus*
208	LEPTO SICI	*Leptodiaptomus sicilis*
209	LEP SICILO	*Leptodiaptomus siciloides*
210	EPI LAC	*Epischura lacustris*
211	E LAC CO	*Epischura lacustris copepodid*
212	LIM MACR	*Limnocalanus macrurus*
213	SEN CALA	*Senecella calanoides*
214	S CAL CO	*Senecella calanoides copepodid*
215	CAL NAUP	*Calanoid nauplius*
216	SE CA NAU	*Senecella calanoides nauplius*
217	DI STAG	*Diaptomus stagnalis*
218	LI MA COP	*Limnocalanus macrurus copepodid*
219	LI MA NAU	*Limnocalanus macrurus nauplius*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
220	NAUP	*Nauplius-calanoid or cyclopoid*
221	COP	*Copepodid-calanoid or cyclopoid*
225	AGLAO SP	*Aglaodiaptomus sp.*
226	DIAPT SP	*Diaptomus sp.*
227	EPIS SP	*Epischura sp.*
228	EURYT SP	*Eurytemora sp.*
229	HESPER SP	*Hesperodiaptomus sp.*
230	LEPTO SP	*Leptodiaptomus sp.*
231	LIMNO SP	*Limnocalanus sp.*
232	ONYCHO SP	*Onychodiaptomus sp.*
233	SENEC SP	*Senecella sp.*
234	SKISTO	*Skistodiaptomus sp.*
301	CYC COP	*Cyclopoid copepodid*
302	C B THOM	*Cyclops bicuspidatus thomasi*
303	CYC SCUT	*Cyclops scutifer*
304	CYC VERN	*Cyclops vernalis*
305	ERG SP	*Ergasilus sp.*
306	EUC AGIL	*Eucyclops agilis*
307	EUC SPER	*Eucyclops speratus*
308	MAC ALBI	*Macrocyclops albidus*
309	MES EDAX	*Mesocyclops edax*
310	ORT MODE	*Orthocyclops modestus*
311	P F POPP	*Paracyclops fimbriatus poppei*
312	T P MEX	*Tropocyclops prasinus mexicanus*
313	CYC NAUP	*Cyclopoid nauplius*
320	ACAN SP	*Acanthocyclops sp.*
321	CYCLOPS	*Cyclops sp.*
322	DIACYC	*Diacyclops sp.*
323	ECTOCYC	*Ectocyclops sp.*
324	ERGA SP	*Ergasilus sp.*
325	EUCYC	*Eucyclops sp.*
326	MACROC	*Macrocyclops sp.*
327	MESOC	*Mesocyclops sp.*
328	MICROC	*Microcyclops sp.*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
329	ORTHOC	*Orthocyclops sp.*
330	PARAC	*Paracyclops sp.*
331	TROPOC	*Tropocyclops sp.*
332	ECTO POLY	*Ectocyclops polyspinosus*
333	EUC SERR	*Eucyclops serrulatus*
334	EUC NEOM	*Eucyclops neomacruroides*
335	E M DENT	*Eucyclops macruroides denticulatus*
336	EUC PRIO	*Eucyclops prionophorus*
337	T P PRAS	*Tropocyclops prasinus prasinus*
338	TRO EXT	*Tropocyclops extensus*
339	ACA ROB	*Acanthocyclops robustus*
340	ACA VENU	*Acanthocyclops venustoides*
341	A V BIS	*Acanthocyclops venustoides bispinosus*
342	ACA CAR	*Acanthocyclops carolinianus*
343	MES AMER	*Mesocyclops americanus*
401	K SER CUR	*Keratella serrulata curvicornis*
501	ANU FISS	*Anuraeopsis fissa*
502	ANU SP	*Anuraeopsis sp.*
503	ASC ECA	*Ascomorpha ecaudis*
504	ASC OVAL	*Ascomorpha ovalis*
505	ASC SP	*Ascomorpha sp.*
506	ASP HERR	*Asplanchna herricki*
507	ASP PRIO	*Asplanchna priodonta*
508	ASP SP	*Asplanchna sp.*
509	ASP MULT	*Asplanchnopsis multiceps*
510	AS_OPSIS	*Asplanchnopsis sp.*
511	BRA ANGU	*Brachionus angularis*
512	BRA CALY	*Brachionus calyciflorus*
513	BRA HAVA	*Brachionus havaniensis*
514	BRA PATU	*Brachionus patulus*
515	BRA QUAD	*Brachionus quadridentata*
516	BRA URCE	*Brachionus urceolaris*
517	BRAC SP	*Brachionus sp.*
518	CEPHA SP	*Cephalodella sp.*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
519	CHRO OVA	*Chromogaster ovalis*
520	CHRO SP	*Chromogaster sp.*
521	COL MUT	*Collotheca mutabilis*
522	COL SP	*Collotheca sp.*
523	COLU UNC	*Colurella uncinata*
524	COLU SP	*Colurella sp.*
525	CONO COE	*Conochiloides coenobasis*
526	CONO EXI	*Conochiloides exiguus*
527	CONO NAT	*Conochiloides natans*
528	CONO SP	*Conochiloides sp.*
529	CON HIPP	*Conochilus hippocrepis*
530	CON UNI	*Conochilus uniconis*
531	CON SP	*Conochilus sp.*
532	EUCHL SP	*Euchlanis sp.*
533	FIL LONG	*Filinia longiseta*
534	FIL TERM	*Filinia terminalis*
535	FIL SP	*Filinia sp.*
536	GAS HYPT	*Gastropus hyptopus*
537	GAS STYL	*Gastropus stylifer*
538	GAS SP	*Gastropus sp.*
539	HEX SP	*Hexarthra sp.*
540	KEL BOST	*Kellicottia bostoniensis*
541	KEL LONG	*Kellicottia longispina*
542	KEL SP	*Kellicottia sp.*
543	KER COCH	*Keratella cochlearis*
544	KER CRAS	*Keratella crassa*
545	KER EARL	*Keratella earlinae*
546	KER HIEM	*Keratella hiemalis*
547	KER QUAD	*Keratella quadrata*
548	KER TAUR	*Keratella taurocephala*
549	KER TEST	*Keratella testudo*
550	KER SP	*Keratella sp.*
551	LEC LIGO	*Lecane ligona*
552	LEC LUNA	*Lecane luna*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
553	LEC MIRA	*Lecane mira*
554	LEC SIG	*Lecane signifera*
555	LEC SP	*Lecane sp.*
556	LEP ACUM	*Lepadella acuminata*
557	LEP PAT	*Lepadella patella*
558	LEP SP	*Lepadella sp.*
559	MONO SP	*Monommata sp.*
560	MON BULL	*Monostyla bulla*
561	MON LUN	*Monostyla lunaris*
562	MON QUAD	*Monostyla quadridentata*
563	MON SP	*Monostyla sp.*
564	NOTH ACU	*Notholca acuminata*
565	NOTH LAB	*Notholca labis*
566	NOTH SQU	*Notholca squamula*
567	NOTH SP	*Notholca sp.*
568	PLA PATU	*Platyias patulus*
569	PLA SP	*Platyias sp.*
570	PLOE LEN	*Ploesoma lenticulare*
571	PLOE TRI	*Ploesoma tricanthum*
572	PLOE TRU	*Ploesoma truncatum*
573	PLOE SP	*Ploesoma sp.*
574	POLY DOL	*Polyarthra dolichoptera*
575	POLY EUR	*Polyarthra euryptera*
576	POLY MAJ	*Polyarthra major*
577	POLY REM	*Polyarthra remata*
578	POLY VUL	*Polyarthra vulgaris*
579	POLY SP	*Polyarthra sp.*
580	POM SUL	*Pompholyx sulcata*
581	POM SP	*Pompholyx sp.*
582	SYN OBL	*Synchaeta oblonga*
583	SYN PEC	*Synchaeta pectinata*
584	SYN STYL	*Synchaeta stylata*
585	SYN SP	*Synchaeta sp.*
586	TEST PAT	*Testudinella patina*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
587	TEST SP	*Testudinella sp.*
588	TRIC CYL	*Trichocerca cylindrica*
589	TRIC HIP	*Trichocerca hippocrepis*
590	TRIC MUL	*Trichocerca multicrinis*
591	TRIC LON	*Trichocerca longiseta*
592	TRIC POR	*Trichocerca porcellus*
593	TRIC ROU	*Trichocerca rousseleti*
594	TRIC SIM	*Trichocerca similis*
595	TRIC SP	*Trichocerca sp.*
596	TRI POCI	*Trichotria pocillum*
597	TRI TETR	*Trichotria tetractis*
598	TRI SP	*Trichotria sp.*
599	UNID ROT	*Unidentified rotifer*
601	C PUNC 1	*Chaoborus punctipennis instar 1*
602	C PUNC 2	*Chaoborus punctipennis instar 2*
603	C PUNC 3	*Chaoborus punctipennis instar 3*
604	C PUNC 4	*Chaoborus punctipennis instar 4*
605	C PUNC P	*Chaoborus punctipennis pupa*
606	C PUNC	*Chaoborus punctipennis*
607	C FLAV 1	*Chaoborus flavicans instar 1*
608	C FLAV 2	*Chaoborus flavicans instar 2*
609	C FLAV 3	*Chaoborus flavicans instar 3*
610	C FLAV 4	*Chaoborus flavicans instar 4*
611	C FLAV P	*Chaoborus flavicans pupa*
612	C FLAV	*Chaoborus flavicans*
613	C TRIV 1	*Chaoborus trivittatus instar 1*
614	C TRIV 2	*Chaoborus trivittatus instar 2*
615	C TRIV 3	*Chaoborus trivittatus instar 3*
616	C TRIV 4	*Chaoborus trivittatus instar 4*
617	C TRIV P	*Chaoborus trivittatus pupa*
618	C TRIV	*Chaoborus trivittatus*
619	C AMER 1	*Chaoborus americanus instar 1*
620	C AMER 2	*Chaoborus americanus instar 2*
621	C AMER 3	*Chaoborus americanus instar 3*

Table 2 (cont'd.)

SPECIES_ID	SPECIES_ABBREV	SPECIES_NAME
622	C AMER 4	*Chaoborus americanus instar 4*
623	C AMER P	*Chaoborus americanus pupa*
624	C AMER	*Chaoborus americanus*
625	C ALBA 1	*Chaoborus albatus instar 1*
626	C ALBA 2	*Chaoborus albatus instar 2*
627	C ALBA 3	*Chaoborus albatus instar 3*
628	C ALBA 4	*Chaoborus albatus instar 4*
629	C ALBA P	*Chaoborus albatus pupa*
630	C ALBA	*Chaoborus albatus*
631	CHAOB SP	*Chaoborus sp.*
632	CHAO PUP	*Chaoborus sp. pupa*
633	CHAOB I1	*Chaoborus sp. instar 1*
634	CHAOB I2	*Chaoborus sp. instar 2*
635	CHAOB I3	*Chaoborus sp. instar 3*
636	CHAOB I4	*Chaoborus sp. instar 4*
637	MYSIS	*Mysis relicta*
701	PERIDIN	*Peridinium spp.*
702	DINOBRYON	*Dinobryon spp. Colonies*
703	CERATIUM	*Ceratium hirundinella*

Table 3 Contents of the Z_CODE table (September 1992).

TABLE	PARAMETER	CODE	DESCRIPTION
Z_SAMPLE	STYPE_CODE	COMP1	composite of several vertical hauls at one station
		COMP2	composite of vertical hauls from several stations
		COMP3	a single vertical haul at one station
		DIS1	sample from a discrete depth
		DIS2	composite of >1 station at 1 depth
		DIS3	composite of >1 discrete depth at one station
		DIS4	composite of >1 discrete depth at >1 station
		DIS5	epilimnetic composite of S/P traps
		DIS6	hypolimnetic composite of S/P traps
Z_SAMPLE	TECH_CODE	TP	Trevor Pawson
		NY	Norm Yan
		BO	Brian O'Reilly
		DH	Dave Howell
		SD	Sheila David
		RG	Robert Girard
		KR	Kim Ralph
		JC	Jim Carbone
		WK	Bill Keller
Z_SAMPLE	XS_CODE	SS	special study
		QAQC1	replicate sample series
		UNREP	sample unrepresentative of community
		REG	regular sample
		IRREG	irregular sampling strategy
		MSLBD	bench sheet mislabelled
Z_SAMPLE	LOC_CODE	WG	William Geiling
		DRC	Dorset Research Centre
		CT	Claudiu Tudorancea

Table 3 (cont'd.)

TABLE	PARAMETER	CODE	DESCRIPTION
Z_SAMPLE	STUDY_CODE	APIOS	Acid Precipitation in Ontario study
		LCS	Lakeshore Capacity Study
		SES	Sudbury Environmental Study
		YORK	York University
Z_SAMPLE	VOLCALC_CODE	1	actual w & w/o haul data
		2	actual w & fixed w/o data
		3	assumed 100% efficiency
		4	s/p trap vol * # of stations
		5	s/p vol * proportion of that strata
Z_COUNT	CNT_TYPE_CODE	QAQC1	replicate count with same count protocol
		QAQC2	repeat count with different count protocol
		R	routine
		SS	special study
Z_COUNT	CNT_SYSTEM_CODE	Z2S1	Zebra2, Sprules caliper #1
		Z2F2	Zebra2, Fowler calipers #2
		Z1F1	Zebra1, Fowler calipers #1
		Z1S1	Zebra1, Sprules caliper #1
		DM	dissecting microscope, counts without measurements
		CM	compound microscope, counts without measurements
Z_COUNT	TECH_CODE	WG	William Geiling
		CT	ClaudiuTudorancea
		NY	Norm Yan
		RS	Richard Strus
		BC	Bruce Cave
		MP	Mike Paylor
		RJ	Roberto Jain
		JM	Judy McClellan

Table 3 (cont'd.)

TABLE	PARAMETER	CODE	DESCRIPTION
Z_COUNT	CNT_PRTCL_CODE	R1	entire sample counted (SES 73-79)
		R2	total count fixed at 350-400 (LCS 1975 TO 1980)
		R3	250 animals, <50 per taxon, <30 nauplii
		R4	50 animals of SP135 & 142 counted (Plastic Lake 1988,89)
		R5	50 animals of all large zooplankton (York protocol)
Z_COUNT	ROTIFER_INDEX_CODE	1	rotifers are extremely abundant
		2	rotifers are abundant
		3	typical rotifer abundance
		4	rotifers are rare
		5	rotifers are extremely rare
Z_COUNT	CNT_GRP_CODE	CRUST	count of crustacea only
		CHAOB	count of chaoborus only
		ROT	count of rotifers only
		C_R	count of both crustacea & rotifers
		CCRA	crustacea, chaoborus, rotifers and algae
		CCR	crustacea, chaoborus and rotifers
		TAXON	count of 1 taxon only
Z_COUNT	OMIT_CODE	SWARM	patch of zooplankton sampled numbers too high
		DENT	species entered twice on benchsheet
		SSPCT	suspect count
Z_CHANGE	TECH_CODE	TP	Trevor Pawson
		NY	Norm Yan

Table 3 (cont'd.)

TABLE	PARAMETER	CODE	DESCRIPTION
Z_GEAR	TYPE_CODE	C/B	DRC modified Clarke-Bumpus sampler
		S/P	Schindler/Patalas trap
		NET	misc. nets
		PUMP	pump sampler
		TUBE	tube sample
		BOTL	sampling bottle e.g., Van Dorn
Z_REMOVE	TECH_CODE	TP	Trevor Pawson
		NY	Norm Yan
Z_SUMMARY	W_CODE	ZEB	biomass from measured animals in that sample
		RLWR1	measured lengths for that lake in other years
		RLWR2	measured lengths from other lakes
		MEAN	grand mean weight for that species from all lakes
Z_SUMMARY	LWR_CODE	Y&M	Yan & Mackie 1987. CJFAS 44: 382 (for sp. 135)
		CUL	Culver et al. 1985. CJFAS 42: 1380.
		SPRL	Sprules et al. pers. comm.
		MCAUL	MCCauley. (IBP) 1984
Z_VOLUME	TECH_CODE	TP	Trevor Pawson
		NY	Norm Yan
Z_VOLUME	TECHNIQUE_CODE	FS	folsom splitter
		BBL	mixing by bubbling and pipeting
		STIR	mixing by figure 8 stirring and pipeting

Table 3 (cont'd.)

TABLE	PARAMETER	CODE	DESCRIPTION
Z_NOMENCLATURE			
	CHNG_CODE	NEW	a new species
		SPLIT	a split of an old species
		LUMP	lumping of old spp.
		NAME	new name for old species
		GONE	a name no longer used